# Kunio MITUI*: **Chromosome studies on Japanese ferns (4)**

# 三井邦男*: 日本のシダの染色体の研究 (4)

The relation between geographical distribution and polyploidy in higher plants has been discussed by a number of workers and it has been elucidated that in general the polyploidy plays the important part of the geographical distribution of plants (for instance, altitudinal distribution and/or condition of habitat). For clarifying this relation in ferns, I observed in this time chromosome numbers of 28 species, which were distributed mostly in higher mountain zone in Japan. The chromosome counts were made with Newcomer's fixation and with the usual acetocarmine squash method. The results are shown in Tab. 1 and figs. 4-30. I would like to express my sincere thanks to Prof. H. Ito for valuable advice and identification of materials.

## Observations and discussion

**Athyrium crenatum** var. **glabrum:** I reported n=80 for this species (1968), however, all of the specimens collected in three localities showed irregular meiosis, approximately 41 bivalents and 41 univalents at diakinesis (fig. 1). Approximately sixty-four spores were contained in a sporangium and the majority of them showed the normal bilateral shapes except for several sterile wrinkled spores (fig. 2). Similar situation of the spore formation under the irregular meiosis was found in the autotriploids of *Lepisorus thunbergianus* and *Phegopteris decursivepinnata* and in *Dryopteris lacera* f. *intermedia* and *Polystichum*×*miuranum* (Mitui, 1968). Brögger (1960, in Fabbri) has reported n=41 for *Athyrium crenatum*, but there has not been found the diploid type of this species yet by this time. Therefore, it seems that these specimens should be autotriploids or derivatives from hybridization between species which seemed to be *A. crenatum* and other closely related species.

**Asplenium capillipes:** Large thirty six bivalents were observed in meiosis and each sporangium contained 32 spores instead of 64 spores (fig. 3). It has been reported already that this is one of the characteristics of apogamous species in homosporous ferns. If this species were apogamous, the basic

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Table 1. Chromosome numbers of some mountain ferns.

| Species | Locality | Haploid chromosome number | Ploidy | Fig. |
|---|---|---|---|---|
| *Asplenium capillipes* | T. | 36 | ? | 4 |
| *A. viride* | T. | 36 | 2× | 5 |
| *Athyrium crenatum* var. *glabrum* | T. S. N. | meiosis irregular | 3× | 6 |
| *A. deltoidofrons* | S. | 120 | 6× | 7 |
| *A. melanolepis* | T. | 40 | 2× | 8 |
| *A. pycnosorum* | T. | 40 | 2× | 9 |
| *A. pterorachis* | S. | 40 | 2× | 10 |
| *A. rupestre* | S., Nekodake | 40 | 2× | 11 |
| *Cornopteris crenulatoserrulata* | N. | 40 | 2× | 12 |
| *Crypsinus veitchii* | N. S. | 72 | 4× | 13 |
| *Cystopteris fragilis* | N. | 126 | 6× | 14 |
| *Dryopteris austriaca* | S. | 41 | 2× | 15 |
| *D. crassirhizoma* | S. | 41 | 2× | 16 |
| *D. kominatoensis* | S. | meiosis irregular | 2× | 17 |
| *D. monticola* | Okukinu, Totigi | 41 | 2× | 18 |
| *D. polylepis* | Nippara, Tokyo | 41 | 2× | 19 |
| *Gymnocarpium jessoense* | T. | 40 | 2× | 20 |
| *Hypodematium fauriei* | Nippara, Tokyo | 80 | 4× | 21 |
| *Lastrea quelpaertensis* | S. | 34 | 2× | 22 |
| *Lepisorus annuifrons* | Toyamagawa, Nagano | 35 | 2× | 23 |
| *L. clathratus* | T. | c. 70 | 4× | |
| *Phegopteris polypodioides* | S. | 90 | 3× apog. | 24 |
| *Pleurosoriopsis makinoi* | Toyamagawa, Nagano | 72 | 4× | 25 |
| *Polystichopsis maximowiczii* | N. | 41 | 2× | 26 |
| *P. mutica* | N. | 41 | 2× | 27 |
| *Polystichum braunii* | N. | 82 | 4× | 28 |
| *P. inaense* | T. | 41 | 2× | 29 |
| *Woodsia glabella* | T. | c. 40 | 2× | 30 |

Abbreviations: N: Nyugasayama, Yamanasi Pref. S: Sugadaira, Nagano Pref. T: Toyogutiyama, Nagano Pref.

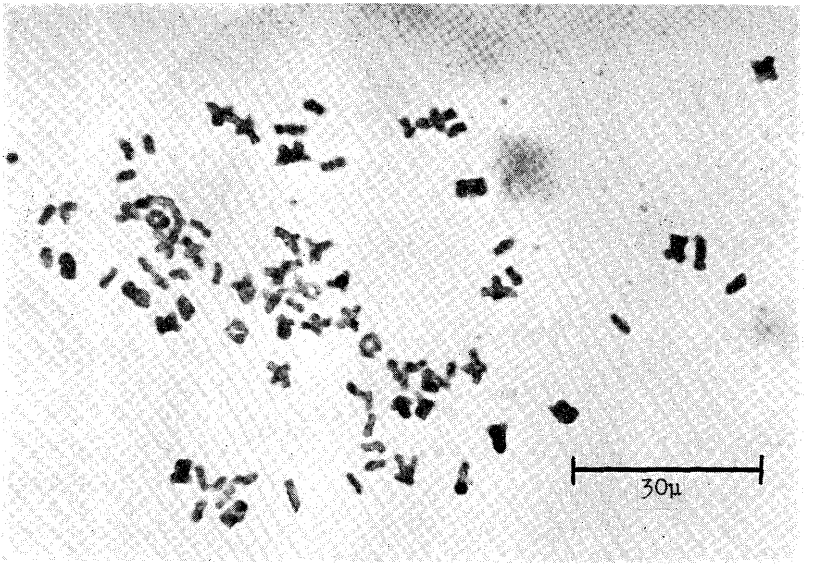



Fig. 1. Meiosis in *Athyrium crenatum* var. *glabrum*.

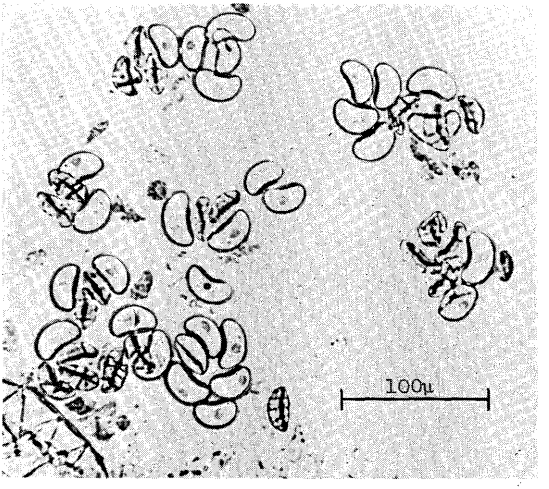



Fig. 2. Spores of *Athyrium crenatum* var. *glabrum*.

chromosome number of this genus (x=36) must be the secondary one derived from primary one. It has been expressed that the present basic number of some genera, (*Osmunda*, *Mecodium*, *Pteris* and *Lepisorus*) must be secondary ones (Tatuno, 1967, 1969, Mitui, 1968).

**Phegopteris polypodioides:** Hirabayashi (1969) suspected the existence of triploid apogamous plants of this species in Japan from the standpoint of the spore observation. The materials collected in Sugadaira district appar-

ently showed the triploid apogamous phase, that is, large 90 bivalents in meiosis and 32 spores in one sporangium. Therefore, it is clarified that this species has two cytotypes, diploid and triploid. In this genus, polyploidization may be one of the causes of manifestation of apogamy as in other genera.

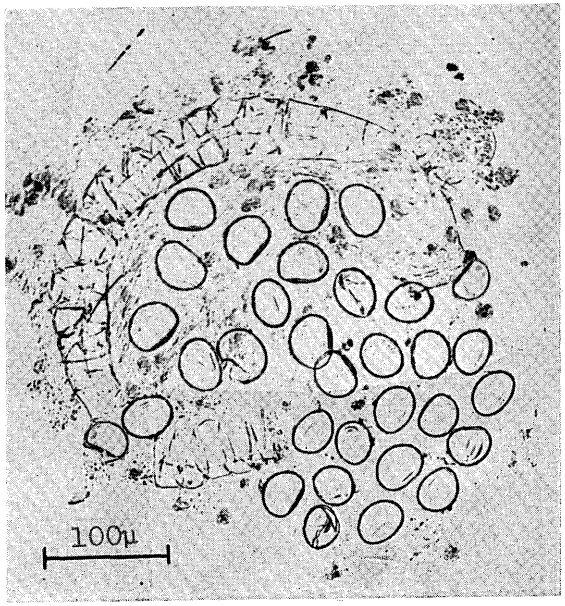
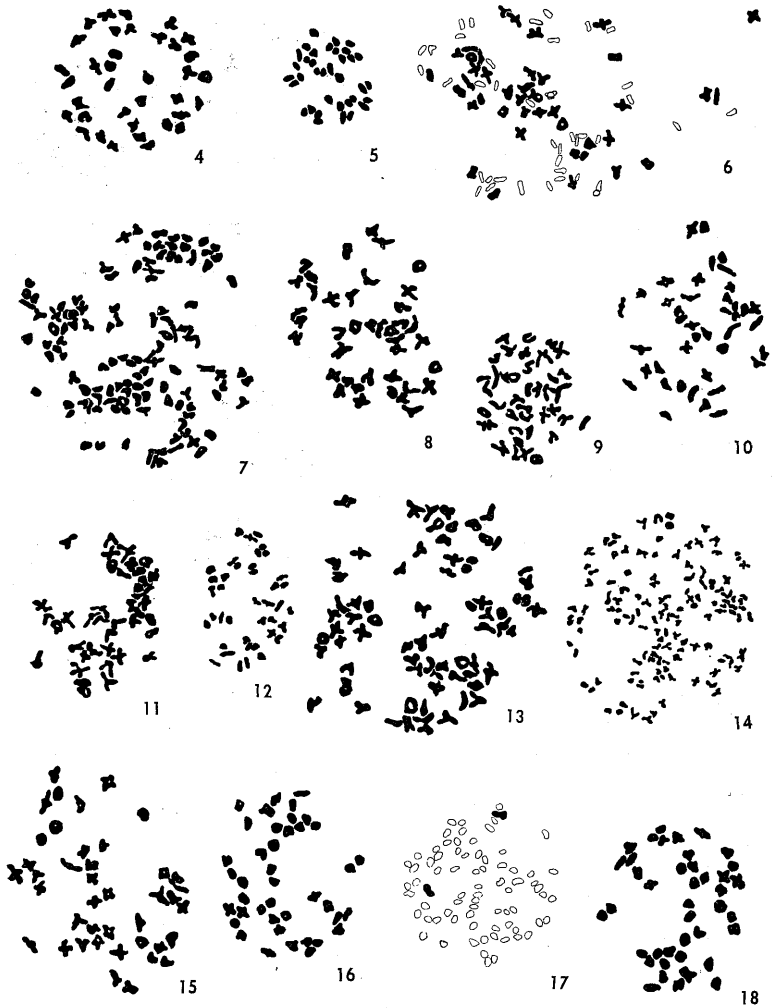



Fig. 3. Spores of *Asplenium capillipes*.

**Lepisorus clathratus:** Approximately 140 somatic and 70 gametic chromosomes were calculated. The chromosome number of this species has not been reported in other countries. There are some remarkable differences in the quantitative characters between Japanese specimens and Chinese ones. For example, the stomatal size of Japanese group was 72.2 $\mu$ and Chinese was 54.4 $\mu$. Judging from these results, it may be suggested that the Japanese specimens might be polyploids and the polyploidization should be one of the important factors in which caused wider distribution of this species.

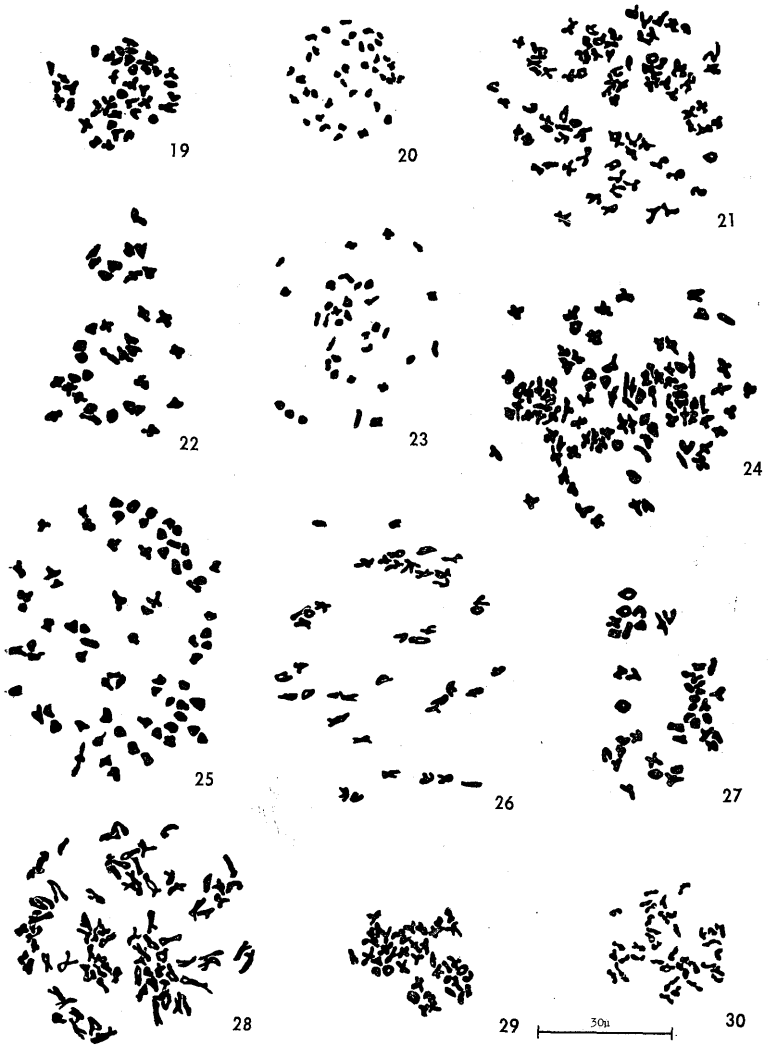
Polyploidy and geographical distribution

The tetraploids grew more inland region than the diploids in the intraspecific polyploids of *Lepisorus thunbergianus*. Also in closely related taxa, the polyploids were found more frequently in inland, mountain and high altitudinal region than the diploids (Mitui, 1968). In the present study, polyploidization could be considered one of the factors for spreading their distribution in some species; for example, *Lepisorus clathratus*, *Athyrium crenatum* var. *glabrum* and *Cystopteris fragilis* and so on. However, the tendency towards polyploidy is not always found in all of the mountain flora. On the contrary, the incidence of polyploidy was somewhat lower in




Figs. 4-18. Numbers correspond to those in tab. 1.

the mountain flora compairing to the whole fern flora in Japan. More exactly, up to the present time, the chromosome numbers of 300 species were calculated in Japanese fern flora and approximately 49% of them were diploids, on the other hand the 50 species out of 300 were considered to be montane plants in their distribution. Of these 50 species, 30 (60%) were




Figs. 19-30. Numbers correspond to those in tab. 1.

diploids. The potentiality to develop to polyploid forms should be somewhat different in different genera. For instance, the tendency towards polyploidy is lower in *Dryopteris, Athyrium* and *Polystichopsis* in mountain flora in Japan.

**References**

Fabbri, F. 1963. Caryologia **16**: 237–335. Hirabayashi, H. 1969. Journ. Jap. Bot. **44**: 113–119. Mitui, K. 1968. Sci. Rep. Tokyo Kyoiku Daigaku. Sec. B. 13, No. 203, 285–333. Tatuno, S. and H. Yoshida 1967. Bot. Mag. Tokyo. **80**: 130–138. Tatuno, S. and M. Takei 1969. ibid. **82**: 121–129.

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分布と倍数性との関連性については，高等植物でかなり報告されている。今回この関連性をシダ類で調べるために山地性のシダ 28 種の染色体数を観察した。これらのうちトヨグチウラボシ，ミヤマシダ，ナヨシダ等の分布には倍数性が強く働いているように思われる。けれども山地性のシダ全体では倍数体の割合はあまり高くない。すなわち現在までに日本ではおよそ 300 種のシダの染色体数が観察されている。これらのうちで倍数体は約 51% である。これに対して約 50 種の山地性のシダのうち，20 種 (40%) が倍数体である。特にオシダ属，メシダ属，カナワラビ属では山岳地域に倍数体が少ない。

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**○高等植物分布資料 (70)** Materials for the distribution of vascular plants in Japan (70)

**○キダチニンドウ** *Lonicera hypoglauca* Miq. 邦内では四国，九州に主産するが，本州では稀種に属し，従来は静岡県と広島県とに報告されていたに過ぎない。東亜の暖一亜熱帯特産種と言える本種が島根県西部，即ち山陰地方にも産することが分ったので報告する。浜田市国府の多陀寺 (Aug. 13, 1969. 宮本 巌) が其の採集地である。標本は若い茎葉であるが，鋭尖の薄い葉，全体に開出毛を布くことで本種と同定した。

**○オオイヌノハナヒゲ** *Rhynchospora Fauriae* Franch. 本種の分布西限は九州であるが，本州中部以北の多雪地帯が主産である。これまで岡山県北部以西の本州に未報告であったが，島根県邑智郡瑞穂町の荷ノ峠 (Aug. 3, 1968. 宮本 巌) に産するのを知った。刺針は殆ど平滑で下半部がわずかに逆粗渋し，果体の 3 倍長あるのでイヌノハナヒゲではない。

**○エゾノミクリゼキショウ** *Juncus Mertensianus* Bong. 太平洋をはさんで東亜と北米西部 (カリフォルニア州南部まで南下) とに分布している湿原生種であり，日本では北海道以南に未報告であった。本種が岩手県和賀・胆沢両郡境の焼石岳に産する。邦内での南限であり，盛岡在住の安本広静氏が 1969 年 8 月 4 日に採集された。

(東京都立大学・牧野標本館 水島正美)